(12) UK Patent Application (19) GB (11) 2 152 221 A

(43) Application published 31 Jul 1985

(21) Application No 8431590

(22) Date of filing 14 Dec 1984

(30) Priority data
(31) 58/244212 (32) 26 Dec 1983 (33) JP

(51) INT CL[4]
G01W 1/10

(52) Domestic classification
G1X 13

(56) Documents cited
EP A1 0123729

(58) Field of search
G1X

(71) Applicant
Casio Computer Co Ltd (Japan),
6-1 2-chome Nishi-shinjuku, Shinjuku-ku, Tokyo, Japan

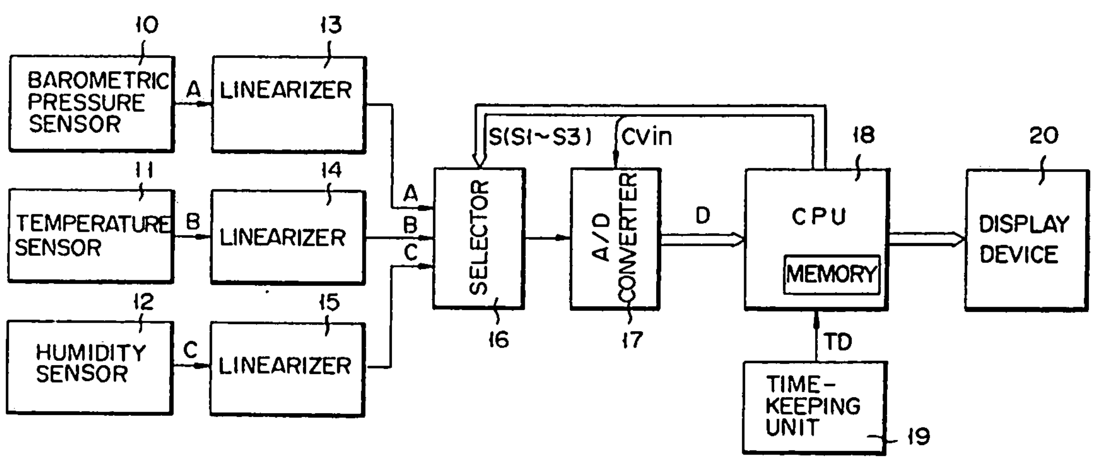
(72) Inventor
Yoshio Ogata

(74) Agent and/or Address for Service
A A Thornton & Co,
Northumberland House, 303-306 High Holborn, London WC1V 7LE

(54) **Weather forecasting apparatus**

(57) A weather forecasting apparatus is adapted to extract weather parameter data at sensors (10, 11, 12) and linearize them in linearizers (13, 14, 15). Any of the weather parameter data is selected by a selector (16), converted by an A/D converter (17) to digital value, and time-sequentially stored in a memory (18a) of a CPU (18). The weather parameter data stored in the memory (18a) is processed by CPU (18) and displayed on a display unit (20), as weather forecasting data.

FIG. 1



GB 2 152 221 A

1/8

2152221

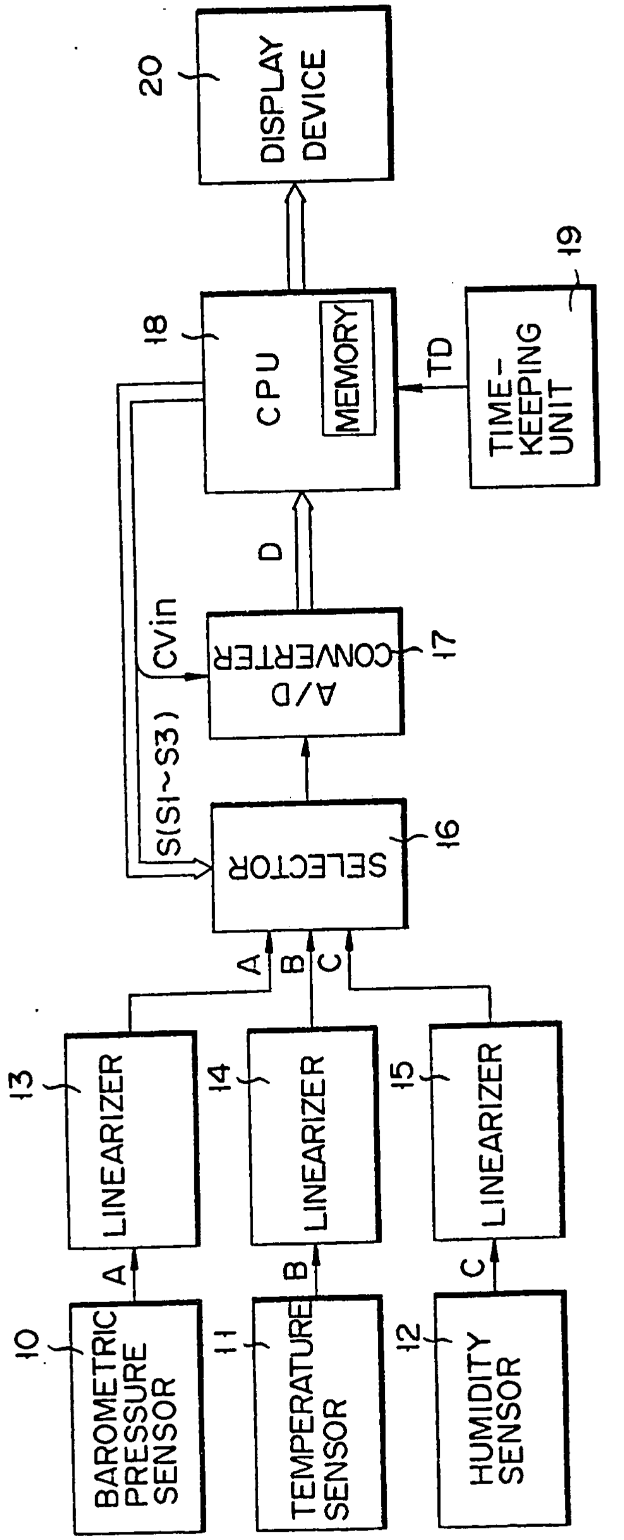


FIG. 1

2/8 2152221

FIG. 2

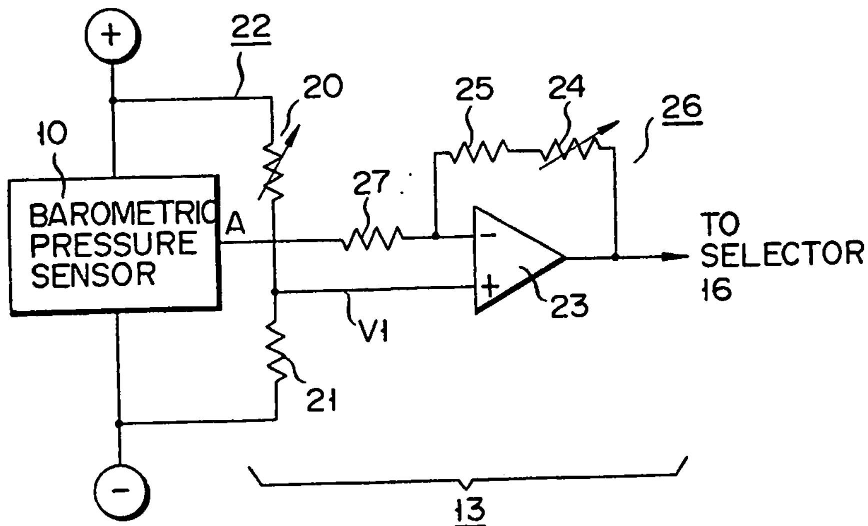


FIG. 3(a)

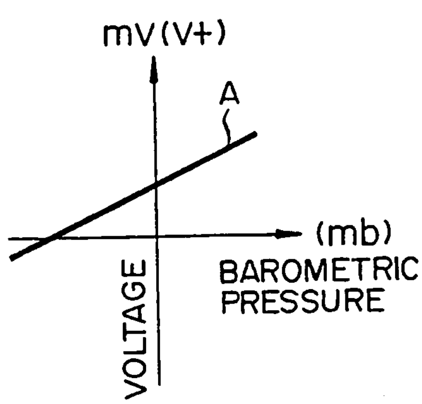
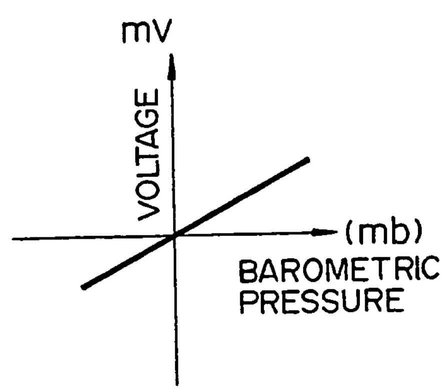


FIG. 3(b)



3/8 2152221

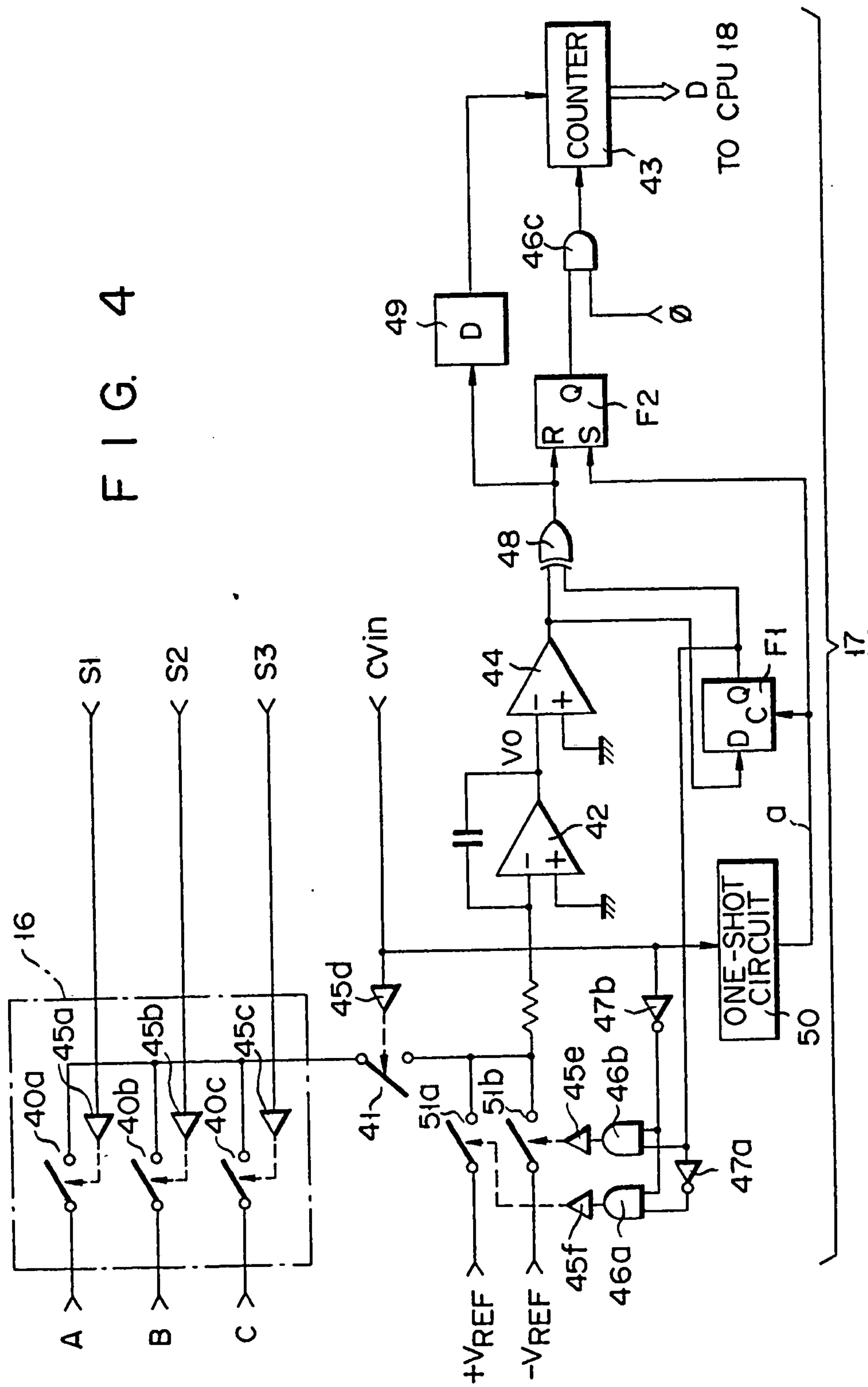


FIG. 4

4/8

2152221

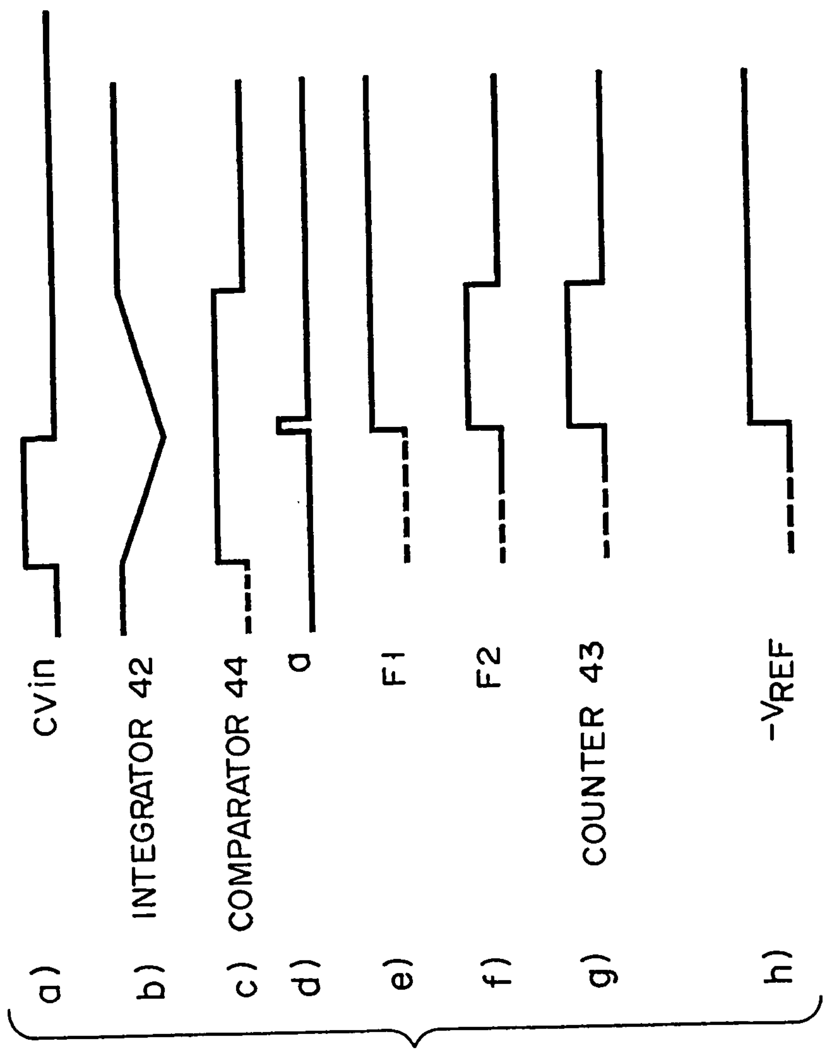
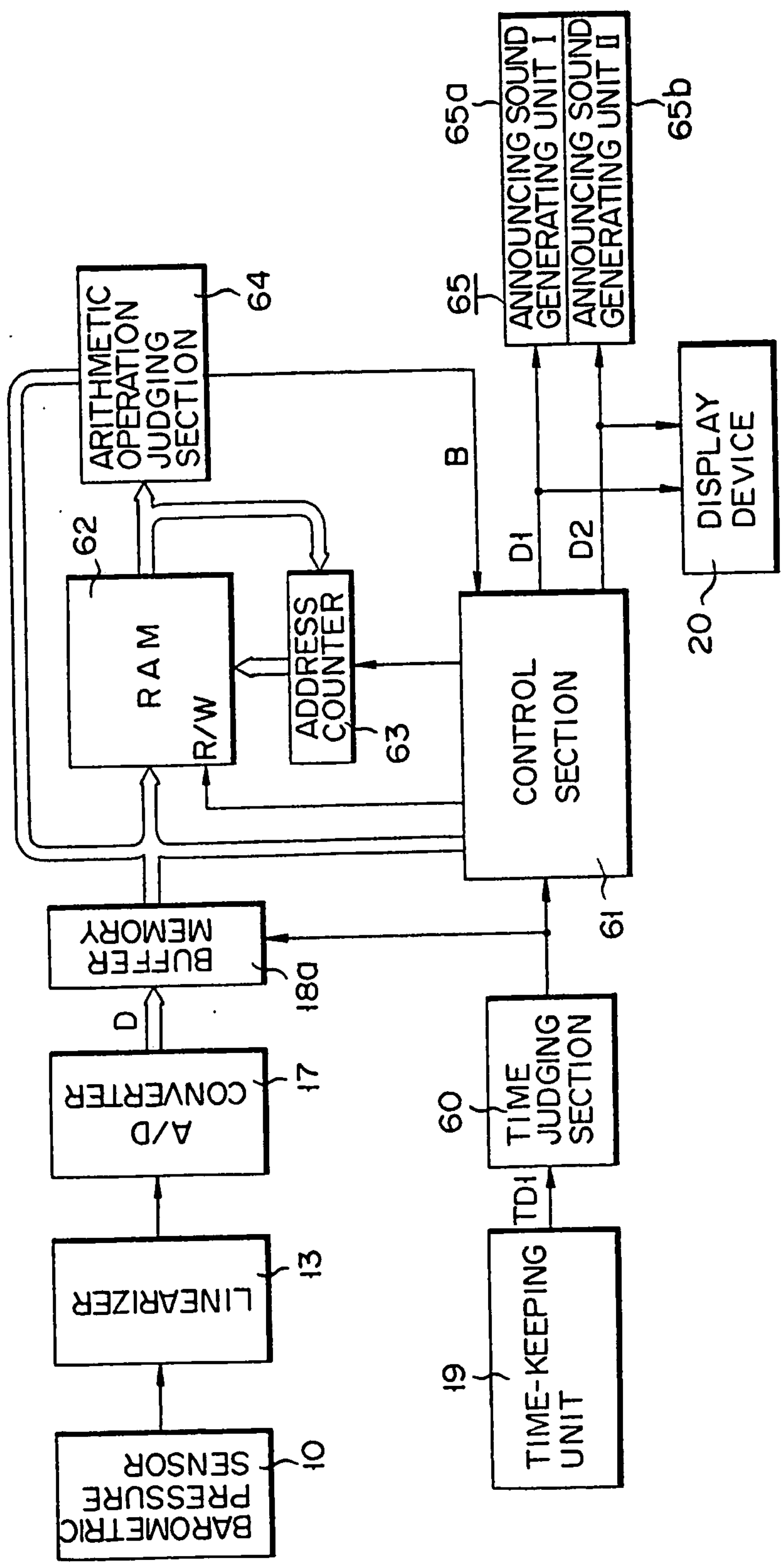


FIG. 5

5/8

2152221

FIG. 6



6/8

2152221

FIG. 7

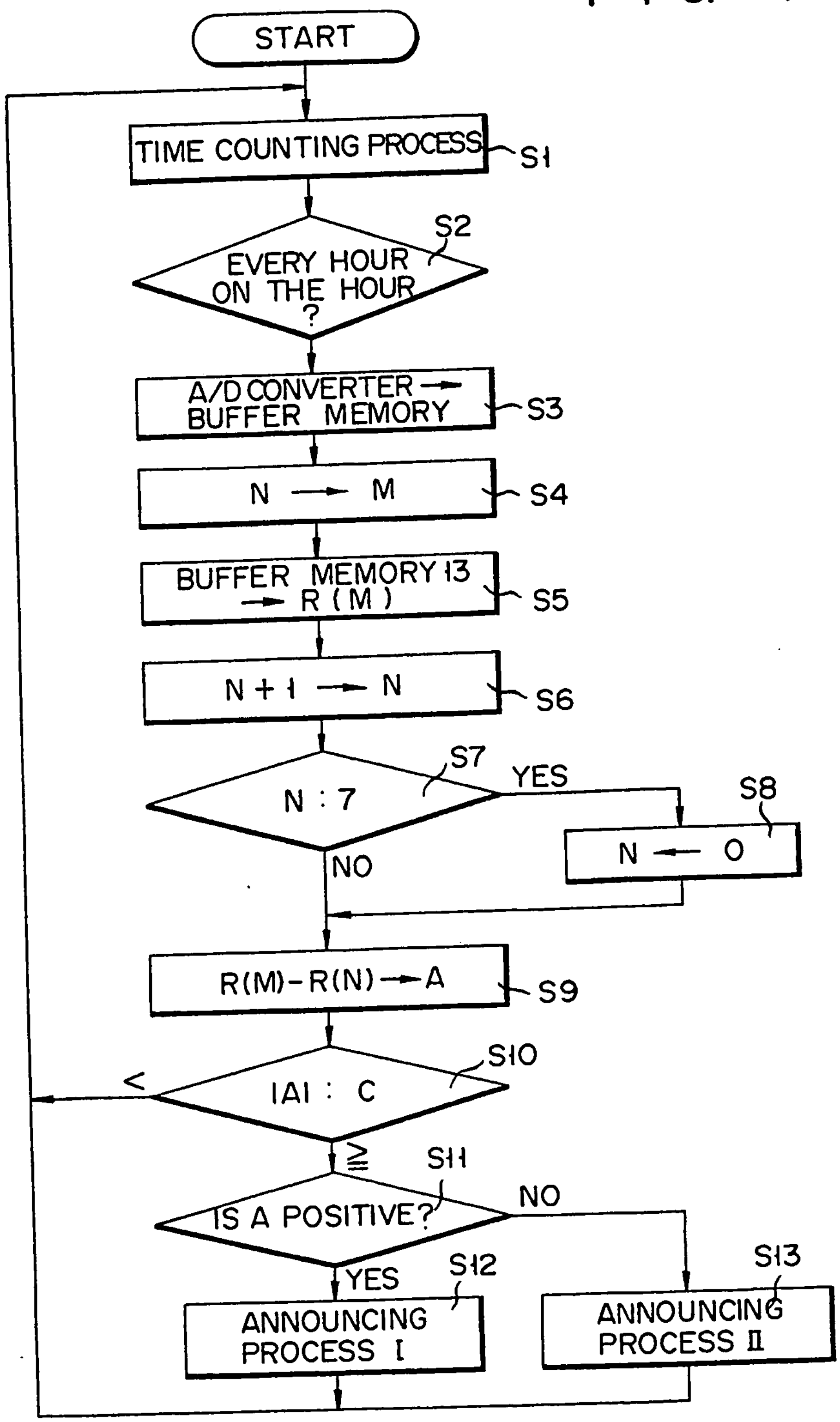


FIG. 8

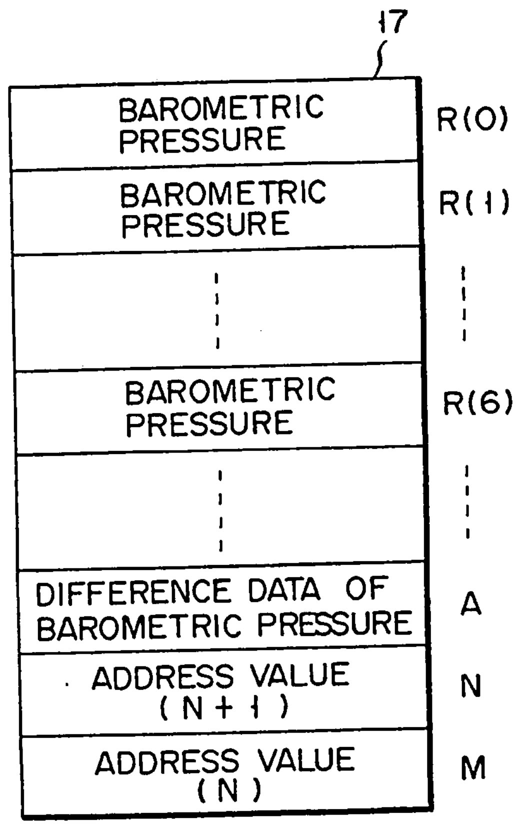

17
BAROMETRIC PRESSURE
R(0)
BAROMETRIC PRESSURE
R(1)
BAROMETRIC PRESSURE
R(6)
DIFFERENCE DATA OF BAROMETRIC PRESSURE
A
ADDRESS VALUE (N+1)
N
ADDRESS VALUE (N)
M

FIG. 9

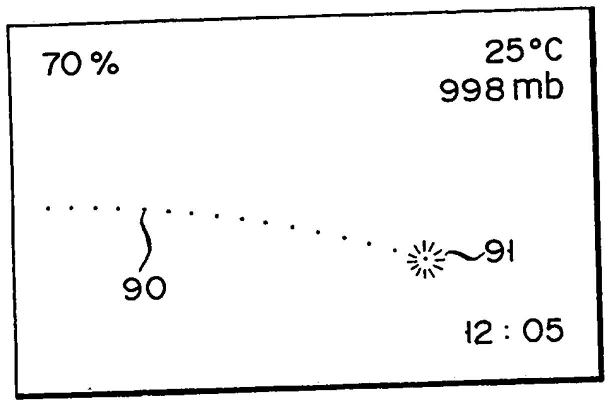
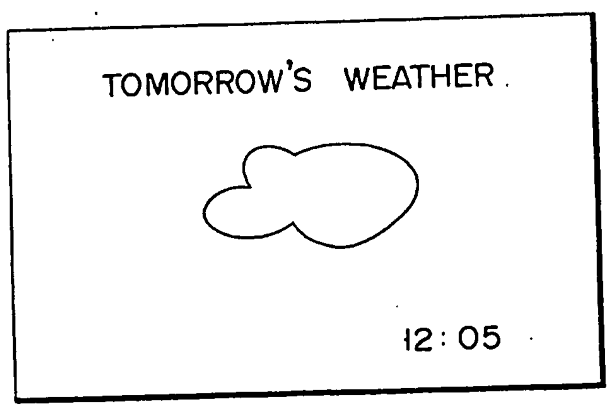


FIG. 10



SPECIFICATION

Weather forecasting apparatus

This invention relates to a weather forecasting apparatus adapted to implement a weather forecasting function on an electronic circuit.

Weather forecasting data is important data to human life, and it is the usual practices to forecast a change of climate in a wide geographical area. However, it is not the common practice to forecast a climatic change prevailing in the narrower geographical area around an observer or a weather forecaster.

The conventional weather forecasting apparatus is usually of a mechanical type using a diaphragm, etc. The apparatus of this type is large in size, high in cost, and liable to be physically affected due to oscillations, mishandling, etc.

This invention has been achieved under these circumstances and an object of this invention is to provide a small-size weather forecasting apparatus which can forecast a change of climate prevailing at a narrow local area around the observer or weather forecaster and which can be stably operated even under outer influences, such as vibrations, to permit ready identification of present weather forecast data.

In order to achieve the above-mentioned object, there is provided a weather forecasting apparatus which comprises a sensor means for extracting weather parameter data varying according to a climatic change; an A/D converter means for converting the weather parameter data extracted by the sensor means to a digital value; a weather parameter data storing means for time-sequentially storing the weather parameter data converted to a digital value; a weather parameter data processing means for preparing weather forecasting data on the basis of the calculated result between present weather parameter data of the weather parameter data time-sequentially stored in the weather parameter data storing means and the weather parameter data present before a predetermined time; and a display means for displaying weather forecasting data prepared by the weather parameter data processing means.

The weather forecasting apparatus of this invention time-sequentially stores weather parameter data such as barometric pressure, temperature, humidity, etc., in a narrower geographical area around a weather forecaster or an observer, prepares weather forecast data on the basis of the weather parameter data and displays it. It is therefore possible to readily and positively known a brief local weather forecast based on such data. Furthermore, according to this invention, it is possible to implement the weather forecasting function by an electric circuit arrangement, and thus it is possible to offer a small-sized weather forecasting apparatus capable of being operated in a stable way, thus permitting the observer to readily know the weather forecast, for example, around his home.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a block circuit diagram showing a weather forecasting apparatus according to one embodiment of this invention;

Fig. 2 is a practical circuit diagram showing a linearizer 13 as illustrated in Fig. 1;

Figs. 3(a) and 3(b) are each a view showing an operation of the linearizer shown in Fig. 2;

Fig. 4 is a practical circuit including a selector 16 and A/D converter *17* as shown in Fig. 1;

Figs. 5(a) to 5(h) are a timing chart for explaining the operation of the A/D converter *17* shown in Fig. 4;

Fig. 6 shows a practical circuit of a weather parameter data processing means for preparing weather forecasting data from barometric data of weather parameter data detected;

Fig. 7 shows a flow chart for explaining the operation of the circuit shown in Fig. 6;

Fig. 8 is a view showing an arrangement of a RAM 62 shown in Fig. 6; and

Figs. 9 and 10 each show an example of the weather forecasting data on a displaying unit shown in Figs. and 6.

A weather forecasting apparatus according to one embodiment of this invention will be explained below in connection with the accompanying drawings.

Fig. 1 shows a block diagram showing an arrangement of a weather forecasting apparatus according to one embodiment of this invention. A barometric pressure sensor 10, temperature sensor 11, and humidity sensor 12 detect the barometric pressure, temperature and humidity, respectively. Detection signals A, B and C of the sensors 10, 11 and 12 are supplied to corresponding linearizers 13, 14 and 15, respectively, where they are linearized to be supplied to a selector 16. The linearizers 13, 14 and 15 are each comprised of a circuit as shown, for example, in Fig. 2. The linearizer 13 includes the barometric pressure sensor 10 (usually a solid-state semiconductor sensor) connected between the power source terminals and a voltage divider *22* comprising a series connection of an originadjustsing variable resistor 20 and resistor 21. The voltage divider *22* connected between the power source terminals generates a linearized output A on the basis of a signal which is detected at the barometric pressure sensor 10. A voltage-divided voltage V1 from the voltage divider *22* is supplied to a noninverting input terminal of an operational amplifier 23. The detection signal A of the barometric sensor 10 is supplied through a resistor 27 to an inverting input terminal of the operational

amplifier 23. The operational amplifier 23 includes a feedback circuit *26*, connected between the inverting terminal of the operational amplifier 23 and an output terminal, and comprises a resistor 25 and a variable resistor 24 for adjusting a slope of the linearized output of the detection signal A. The linearizer 13 causes the detection signal A of the barometric pressure sensor 10 as shown in Fig. 3(a) to be linearized, as shown in Fig. 3(b).

The selector 16 selects respective detection signals A, B and C, which are supplied from the linearizers 13, 14 and 15, according to a select signal (S1, S2, S3) from a microprocessor (hereafter referred to as a CPU) and delivers a selected signal to an analog/digital converter 17 (hereafter referred to as an A/D converter).

The A/D converter 17 converts the respective detection signal (A, B, C) of the selector 16 to a digital signal D according to a control signal CVin from CPU 18 and sends it to CPU 18. The selector 16 and A/D converter 17 are constructed as shown, for example, in Fig. 4. The selector 16 includes switch circuits 40a, 40b and 40c controlled by the select signals S1, S2 and S3 of CPU 18. The respective detection signals A, B and C are supplied respectively through switch circuits 40a, 40b and 40c to the A/D converter 17. As this time, the respective detection signals A, B and C are supplied to the A/D converter 17 through a switch circuit 41 controlled by the control signal CVin from the CPU, noting that the A/D converter 17 is comprised of, for example, a double integral system. The A/D converter 17 utilizes a principle on which the output voltage of an integrator 42 is proportional to a product of the magnitude of the input voltages (A, B, C) and a time length over which the input signal is supplied.

As shown in Fig. 5(a), when the control signal CVin is fed from CPU 18, the detection signal A, for example, is input to the integrator 42 through the switch circuit 41, thus starting an integrating action. At the same time, as shown in Fig. 5(c), a comparator 42 produces a comparison output based on a comparison between a reference potential (ground level) and an output of the integrator 42. Upon a fall of the waveform of the control signal CVin, a "fall" one-shot circuit 50 produces a one-shot pulse a, as shown in Fig. 5(d), to cause a flip-flop F1 to be driven as shown in Fig. 5(e). 8ince at this time the comparator 44 delivers the output to an exclusive OR circuit 48, no output appears from the exclusive OR circuit 48. Upon receipt of the oneshot pulse a, a flip-flop F2 is set, and the output of the flip-flop F2 is supplied through an OR circuit 46c to a counter 43. The counter 43 starts a count operation, as shown in Fig. 5(g), in synchronism with the fall of the control signal CVin. At the fall of the control signal CVin, an AND circuit 46b receives an output from an inverter 47b and an output of the flip-flop F1 and delivers an output through a driver 45e to a switch 15b, where it is closed. As a result, the integrator 42 performs a discharging action, as shown in Fig. 5(b), upon receipt of a reference voltage signal ($-V_{REF}$) as shown in Fig 5(b) At the completion of the discharging action, the output of the comparator 44 is zero, and thus the exclusive OR circuit 48 delivers an output to a flip-flop F2, where it is set. As a result, the counter 43 stops its count operation. A ratio between the measured voltage level of the detection signal A and the reference voltage level corresponds to a time period from the starting of an integrating action from a zero level until returning to a zero volt through the discharging action. As a consequence, the count value from the starting of the count operation of the counter 43 to the stopping of the count operation, as shown in Fig. 5(g), corresponds to a digital output D of the detection signal A.

In Fig. 4, reference numerals 45a to 45f show drivers, 46a to 46c denote AND circuits, and 49 shows a delay circuit. When the output of the integrator 42 has its polarity opposite to that shown in Fig. 5(b), a plus reference voltage signal ($+V_{REF}$) is supplied through a switch 51a. The digital output signal D from the A/D circuit 17 is supplied to CPU 18 The respective digital signals D representing the barometric pressure, temperature and humidity are time-sequentially stored in a memory 18a of CPU 18, in accordance with time count data TD supplied from a time-keeping unit 19. Weather forecasting data is prepared based on the time-sequentially digital signals in the memory 18a of CPU 18 and displayed on a display unit 20 such as a liquid crystal display unit, a CRT display unit, etc.

A practical circuit arrangement for preparing the weather forecasting data on the basis of the above-mentioned digital signal will be explained below in connection with its operation by referring to Figs. 6 to 8.

The embodiment shown in Fig. 6 shows a case where only the barometric pressure is detected as weather parameter data. A detection output of a barometric pressure sensor 10 is supplied through a linearizer 13 to an A/D converter 17. A digital signal D corresponding to the detection output is stored in a buffer memory 18a. The barometric sensor 10 comprises, for example, a solid-state semiconductor sensor for detecting barometric pressure. The linearizer 13 linearizes the detection signal of the barometric pressure sensor 10 and supplies it to an analog/digital converter 17 (hereafter referred to as an A/D converter), where it is converted to a digital signal. The digital signal is supplied to a buffer memory 18a. The buffer memory 18a time-

sequentially stores barometric pressure data D (digital signal) in synchronism with an every hour signal TD2 from a time judging section 60, for example, for every hour. In this connection it is to be noted that said every hour signal corresponds to every hour on the hour. When, of the time count signals TD1 supplied from a time-keeping unit 19, the every hour signal is judged as such, a time judging section 60 delivers only the every hour signal (TD2) to the buffer memory 18a and control section 61.

Based on an initially stored program, the control section 61 permits barometric pressure data A in the buffer memory 18a to be time-sequentially stored in a RAM 62. RAM 62 sequentially stores the barometric pressure data A in address R(0) to R(6) for every hour that the addresses are set by an address counter 63 in a manner as set out in Fig. 8. In computing judging section 64 reads present barometric data and its preceding barometric data from RAM 62 under the control of the control section 61 to compute a difference between the respective barometric data. When a computed difference level is greater than a predetermined barometric reference level, the computing/judging section 64 delivers to the control section 61 a judged signal B which designates a process for permitting an announcement of a rapid climatic change. The control section 61 delivers rapid climatic change announcing signals DI and D2 to a display section 20 and an announcing sound generating section 65, depending upon the judged signal B. The display section 20 is comprised of, for example, a CRT display device, displaying the rapid climatic change data (i.e., bad or good data) according to the announcing signals D1 and D2. The announcing sound generating section 65 comprises an announcing sound generating unit 65a for announcing a rapid climatic change or bad weather and an announcing sound generating unit 65b for announcing good weather. These units 65a and 65b are operated depending the announcing signals D1 and D2.

The operation of the weather forecasting apparatus wiLl be explained below by referring to Figs. 7 and 8.

The detection signal of the barometric pressure sensor 10 is converted by the A/D converter 17 to a digital signal, and the barometric pressure data D, which is a digital signal, is stored in the buffer memory 18a in step S3 in a flow chart of Fig. 7. At this time, the time count signal TD1, which is obtained through the time counting processing by the time-keeping circuit 19, permits the time judging section 60 to judge whether or not the signal TD1 is an every hour signal TD2 in steps S1, S2. The barometric pressure data D is stored in the buffer memory 18a is synchronism with the every hour signal such as 12:00 or 13:00.

The value of a register N is transferred to a register M in step S4, and then the barometric data D in the buffer memory 18a is stored in RAM 62 at a predetermined address R(M) in step S5. If, at this time, an initial value of the register N is 0, the barometric data D is stored in RAM 62 at an address R(0) as shown in Fig. 8. Present barometric pressure data D are time-sequentially stored in RAM 62 at addresses R(1), R(2)...R(6) according to the every hour signal TD2.

In step S6, the data of the register N is supplied to the computing/judging section 64, where it is incremented by + 1. In step S7, the computing/judging section 64 judges whether or not the content of the register N reaches "7".

When the content of the register N is equal to "7", the process goes to step S8, and the register N is cleared. When, on the other hand, the content of the register N is not equal to "7", then the process goes to step S9.

In step S9, the computing/judging section 64 computes R(M) − R(N) → A, i.e., a difference A between present barometric pressure data stored in the address R(M) of RAM 62 and the oldest barometric pressure data in address R(N) of RAM 62 corresponding to the barometric pressure, six hours earlier than the present barometric pressure.

At step S10, the computing/judging section 64 judges whether or not an absolute value |A| of the difference A exceeds a predetermined barometric constant C (for example, 4 mb) which has been initially set. When the absolute valve |A| of the difference A exceeds the barometric pressure constant C as a result of a judgment (a judged signal B), the control section 61 judges the difference A data to be positive or negative (step S11). If the difference A data is positive, then the control section 61 delivers the climatic change announcing signal D1 to the display section 20, where it displays a trend of a rapid change to bad weather, and to a climatic change announcing section 65a, where a corresponding announcing sound is generated. That is, it is detected that the present barometric pressure level rapidly drops (a level greater than the barometric constant C) in comparison with the earlier level and a corresponding processing I is carried out, indicating that the weather will be bad (step S12). If, on the other hand, the difference A data is negative, then the control section 61 delivers a corresponding signal D2 to the display section 20 where it displays a trend for the weather to be good. At the same time, the corresponding announcing sound generating section 65b delivers a corresponding sound. This is a procedure II carried out at step S13.

In this way, the barometric pressure data is stored for every predetermined time period (for example, for each hour), and the differ-

ence A is found from a subtractive combination of the present barometric pressure data and the earlier data, permitting a time-sequential measurement of a rate of barometric pressure change. When the rate of barometric pressure change exceeds the predetermined reference value (the barometric pressure constant C), a corresponding signal is generated, announcing, in particular, a rapid change to bad weather. As a consequence, where bad weather is forecasted due to a rapid drop in barometric pressure, it is possible to automatically and immediately announce such a rapid climatic change.

How the weather parameter data detected at the respective sensors are displayed on the display section 20 will be explained below by referring to Figs. 9 and 10.

As in the circuit arrangement of Fig. 1, CPU 1 permits the respective weather parameters to be time-sequentially stored in its memory 18a on the basis of time count data supplied to the time-keeping unit 19. In this case, the respective weather parameter data are stored in the memory 18a, for example, for every hour. CPU 18 permits the respective weather data in the memory 18a to be time-sequentially displayed, as required, on the display unit 20. That is, as shown in Fig. 9, for example, the temperature (25°C), humidity (70%) and barometric pressure (998 mb) for a predetermined time (12:05) are displayed as the weather parameters on the display unit 20. The graph, as shown in Fig. 9, plots a barometric pressure change against a predetermined time period (for example, 24 hours) up to the present time, noting that the point 91 shows the present barometric pressure level. The curve for the barometric pressure change graph is time-sequentially displayed on the display unit 20, while under the control of CPU 18, on the basis of the barometric pressure data time-sequentially stored in the memory 18a. The time data is prepared by CPU 18 on the basis of the time data supplied from the time-keeping unit 19. In this way, a brief climatic change at the local area can be forecasted on the basis of the weather parameter data on the display unit 20. It is also possible to announce weather forecasting.

When the respective weather parameter data are time-sequentially stored in the memory as set out above, CPU 18 prepares weather forecasting data as shown, for example, in Fig. 10, on the basis of an initially incorporated program and permits is to be displayed on the display unit 20, noting that Fig. 10 shows cloudy weather. In this case, CPU 18 forecasts a climatic change from the relation of a variation in the local weather to the trend of, for example, a barometric change around the observer, which is measured from the barometric pressure variation graph 90, and effects data processing for preparing weather forecast data. It is therefore possible to immediately obtain the weather forecasting data on the screen of the display unit 20.

CLAIMS

1. A weather forecasting apparatus comprising:

sensor means for extracting weather parameter data varying according to climatic change;

A/D converter means for converting the weather parameter data extracted by said sensor means to digital data;

weather parameter data storing means for timesequentially storing the weather parameter data so converted;

weather parameter data processing means for preparing weather forecasting data on the basis of a computation result between the present data of the weather parameter data, time-sequentially stored in said weather parameter data storing means, and weather parameter data prevailing before a predetermined time; and

display means for displaying the weather forecasting data prepared by said weather parameter data processing means.

2. The weather forecasting apparatus according to claim 1, in which said sensor means extracts any of a barometric pressure, temperature and humidity as weather parameter data.

3. The weather forecasting apparatus according to claim 1, in which said A/D converter means includes an integrator for effecting a double integral operation on the weather parameter data extracted by said sensor means and a counter for generating a digital value as a count output which corresponds to the integral operation time of said integrator.

4. A weather forecasting apparatus, substantially as hereinbefore described with reference to the accompanying drawings.

Printed in the United Kingdom for
Her Majesty's Stationery Office, Dd 8818935, 1985, 4235
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.